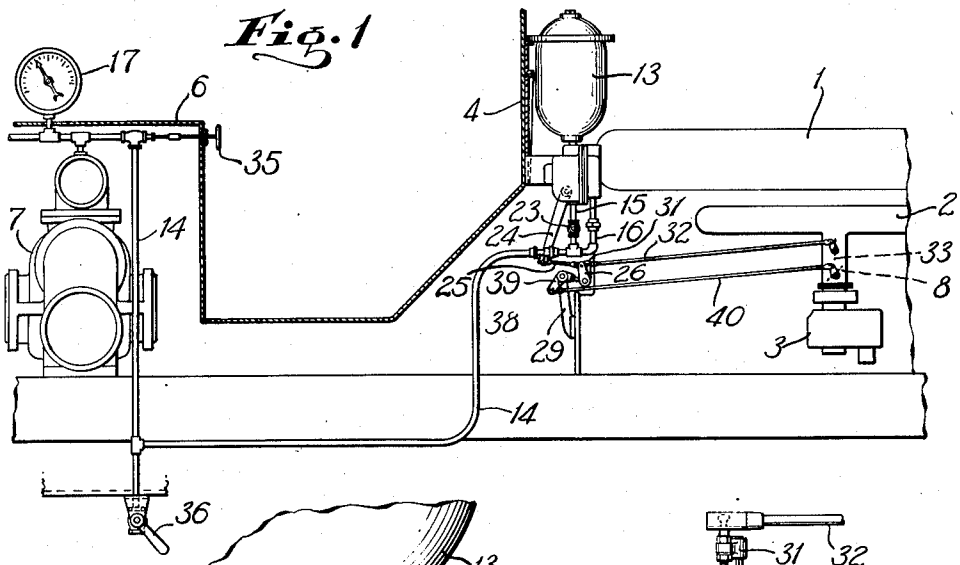
May 11, 1937. H. WALKER 2,079,781

PRESSURE CONTROL MECHANISM

Filed Dec. 26, 1934

Fig. 1



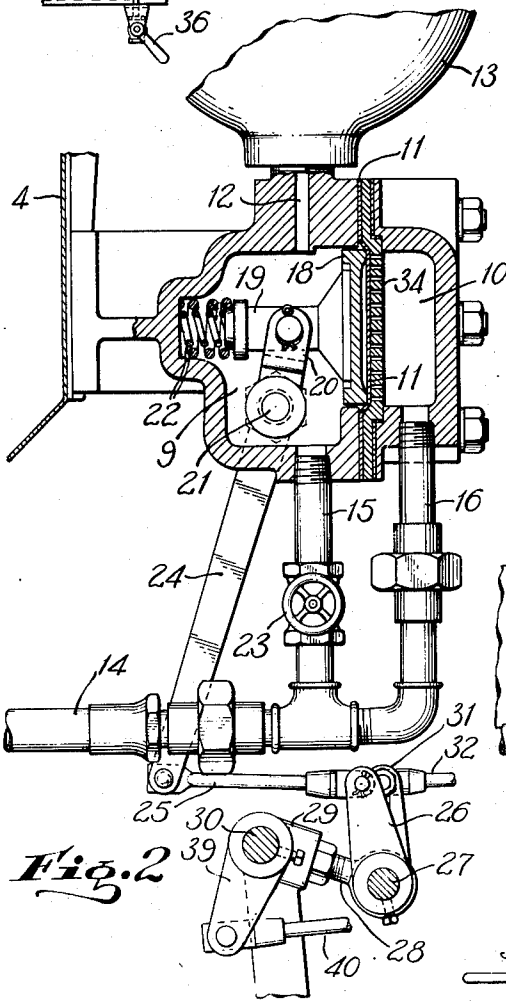


Fig. 2

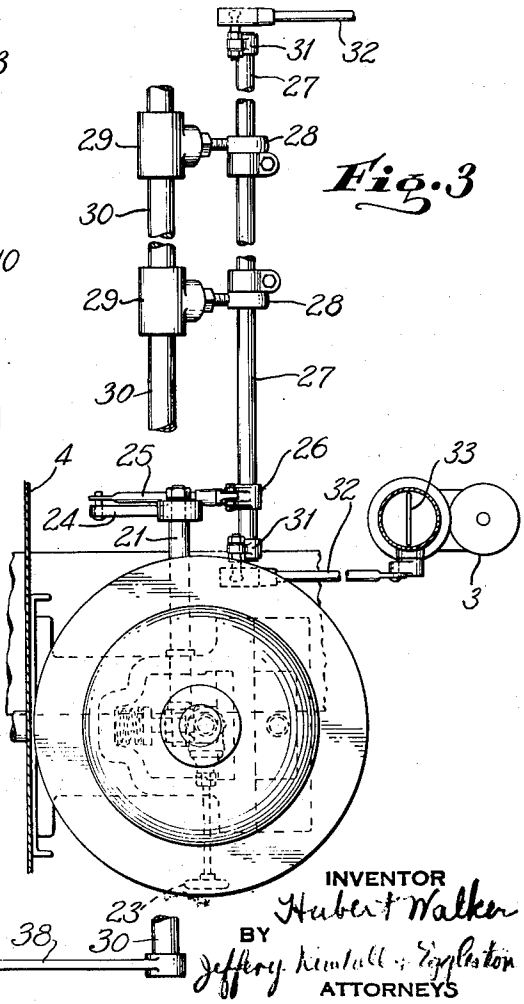


Fig. 3

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PRESSURE CONTROL MECHANISM

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Application December 26, 1934, Serial No. 759,207

4 Claims. (Cl. 103—16)

The object of the invention is an automatic mechanism for establishing predetermined and variable, practical limits to the pressure which can occur in a water pumping system and, more especially, for limiting the operating pressure of motor pumpers driven by internal combustion engines, to the end of avoiding the building up of unduly high hose-line pressures and to accomplish these results by simple, rugged mechanism especially suitable for use with centrifugal pumps.

This invention employs a control element such as a piston or diaphragm which is subject to the varying operating pressures which obtain in the system and which is movable in response thereto when a predetermined limit is exceeded, but in accordance with the invention the pressure which opposes movement of the control element is that of a body of water and air which is compressed by the water pump itself and which body, when its pressure substantially equals the desired limit, is closed off from further communication with the pump so that it continually offers that limit pressure to sustain the control element against movement. In other words, the element is differentially controlled by the water pressure at which the pump is initially set to discharge and the varying water pressure resulting from the opening and closing of hose lines as their services are or are not required.

In the preferred form of the invention various other features are provided, having to do with the adaptation and application of the control mechanism to the special requirements of automotive pumpers, to the end of providing safety and simplicity and convenience of control as are essential to such apparatus, all as described and pointed out in the following description and exemplified in the accompanying drawing in which Fig. 1 diagrammatically illustrates part of the forward end of a fire pump truck with the invention applied, Fig. 2 is an enlarged, part-sectional view of the control mechanism and Fig. 3 is a plan thereof, partly broken out, showing the operating connections.

In the automotive pumper illustrated, the reference 1 indicates the vehicle-propelling power plant, which is also used for driving the pump. It is shown as a V-type engine, the intake manifold and carburetor on the near side being designated 2 and 3 respectively. 4 is the dash separating the engine and driver's compartments and 6 the support for the driver's seat beneath which is mounted the pump 7. In this instance it is a centrifugal pump and driven by the engine 1, under the control of a fuel throttle 8 manually adjustable to vary the engine speed and hence the speed and pressure at which the pump operates to supply water to the several hose lines, not shown.

The automatic pressure control mechanism is conveniently mounted on the front of the dash and in its preferred form comprises two chambers 9 and 10 divided by a rubber diaphragm 11, chamber 9 communicating through passage 12 with an air dome 13 and both chambers, through pipe 14 and its branches 15 and 16, with the high pressure side of the pump. A pressure gauge is shown at 17, indicating the pump discharge pressure.

Mounted within chamber 9 and bearing against the back of the diaphragm is the head 18 of an actuator member 19 the stem of which is pinned to a crank 20, fast on a rock shaft 21, which projects through the wall of chamber 9 through an appropriate gland. Springs 22, engaging the rear end of member 19 serve merely to urge the head toward or in contact with the diaphragm and maintain the latter normally flexed toward chamber 10, as shown.

When the pump is in action its pressure is communicated equally to chambers 9 and 10, through pipes 15 and 16, but pipe 15 is provided with a hand valve 23, readily accessible from the side of the truck, and when this valve is closed chamber 9 and its air dome are shut off from communication with the pump and the air trapped in the dome constitutes a cushion acting on the diaphragm. Thereupon, in the event the pressure in the system increases, such increase, manifested in chamber 10 (which is in open communication with the pump) tends to overcome the resistance opposed by the pressure in chamber 9 and causes the diaphragm and actuator 19 to recede toward chamber 9. In other words, chamber 9 constitutes a control-pressure chamber and chamber 10 an operating-pressure chamber.

While the principle of the mechanism thus far described is susceptible of embodiment in a variety of forms to suit the conditions in hand, the specific form illustrated is particularly appropriate as a means of relieving excess pressure by applying the resulting movement of actuator 19 to control the source of the pressure by reducing the speed of engine 1, as follows:

Rock shaft 21 carries a lever arm 24 which, through link 25 and crank 26, operates a rock shaft 27 journalled in hangers 28 which project from the heads of brackets 29. Shaft 27 extends from side to side of the engine and at its ends is connected, through cranks 31 and links 32,

to auxiliary throttles 33 located in the intakes above throttles 8. The latter are operated by links 40 and cranks 39 on the ends of a rock shaft 30 journalled in brackets 29, which rock shaft is subject to control as usual to adjust the throttle through the connections referred to and so vary the engine speed at will. For the purposes of this invention throttles 8 are preferably subject to manual control from a point sufficiently close to valve 23 as to enable it and the throttles to be readily adjusted from one station and accordingly there is indicated a control handle 38 on the outer end of rock shaft 30 (Fig. 3).

The connections between the actuator and throttles 33 are such that the latter are wide open when the former occupies the position shown (Fig. 2), with the result that when the diaphragm and actuator move toward chamber 9 as the result of a pressure increase in chamber 10, throttles 33 are closed down to effect a reduction of the engine speed and hence of the pump speed and discharge pressure, without regard to the manual setting of throttles 8. It is preferred to organize the actuator-throttle connections so that a full stroke of the actuator toward chamber 9 fully closes throttles 33, thus ensuring that all the intermediate throttle positions actually required in service are well within the permitted stroke of the actuator.

Were the air dome of infinite capacity, its resistance to movement of the actuator (throughout the small stroke indicated) would be constant, practically, so that any excess pressure in chamber 10 would cause the actuator to move back until throttles 33, by reducing the engine and pump speed, restored the previous pressure in the system i. e. the degree of throttle closing would exactly counteract the excess pressure. Actually, of course, the air dome pressure is not constant but increases as the diaphragm moves toward chamber 9, with the result that any tendency to excess pressures in chamber 10, causes the diaphragm and actuator to take up various balanced positions in which the pressure (both in chamber 9 and in chamber 10) is greater than the initial dome pressure. It has been found, however, that if the stroke of the actuator is comparatively short, the size of the dome can be kept within reasonable limits and the working pressure increase therein, and in the system, nevertheless held to such a small amount as in no way to interfere with the result sought viz. the prevention of excessive pressure. In the control illustrated the full actuator stroke is approximately one-half inch and the air dome has a capacity of about 160 cubic inches, and under these conditions the pressure in the system at no time exceeds the limit for which the control is initially set by more than about 10 lbs.

While it is feasible to set the control to respond to very slight pressure increase in chamber 10, that is clearly quite unnecessary and it is convenient, in practice, to permit an increase of say 5 lbs. before calling the control into action. For example, if it is desired to limit the pump discharge to a pressure of about 120 lbs. i. e. so that it will not exceed 120 lbs. to any substantial or dangerous extent, the control is set by opening valve 23, adjusting throttles 8 to produce an engine speed such that gauge 17 shows a pressure of say 125 lbs. and then closing valve 23, thereby establishing a cushion which will yield to pressures in excess of 125 lbs. in chamber 10. The hand throttles are then closed down until the gauge pressure is 120 lbs. In the result, minor pressure increase in chamber 10, that is, less than 5 lbs. (which is not of serious consequence) does not cause the diaphragm to yield but if as the result of the shutting off of one or more hose lines the pressure increase exceeds 5 lbs. the control mechanism responds immediately. The diaphragm and actuator yield, the actuator connections cause the throttles 33 to be partially closed, thereby reducing the engine and pump speeds, and the diaphragm and actuator take up a new position of rest in which the pressures in chambers 9 and 10 are slightly (but, as above explained, not materially) greater than 125 lbs.

Since the setting of the control requires merely the closure of valve 23 at an appropriate gauge pressure, the latter in turn depending only on the setting of throttles 8, any desired limit can be established quickly and with a minimum of effort. Likewise any desired change from one operating limit to another is readily accomplished, requiring simply the opening of valve 23, the re-setting of hand throttles 8 to establish the desired engine speed and pump pressure and the closure of valve 23 at that new pressure.

Prior to stopping the pump, valve 23 should be opened so that when the pressure in chamber 10 is reduced to zero there will not be exerted a large, wholly unbalanced pressure on the back of the diaphragm, but to guard against its rupture should the opening of the valve be overlooked there is provided a rigid, perforated plate 34 on the otherwise unsupported side of the diaphragm. The plate not only serves to support and sustain the diaphragm under the circumstances indicated but also functions as a stop to limit its normal flexure toward chamber 10 under the influence of springs 22.

The construction and arrangement of the control chambers 9 and 10, diaphragm and air dome are such that these parts constitute a self-contained unit capable of ready application to existing apparatus as well as installation on new pumpers and by closure of hand valve 35 in line 14, adjacent the pump, the entire control may be disconnected, to permit inspection or repair, without interfering with the rest of the system or the manual control of the pump by means of throttles 8. To facilitate drainage of the control system a valve 36 is provided at the low point of line 14.

I claim:

1. In an automotive fire pumper having an engine, a fire pump driven thereby and adapted to supply a plurality of hose lines, means for automatically maintaining predetermined operation of the pump by the engine comprising an element constantly urged in one direction by the pressure of the water discharged by the pump, a dome having a body of air and water confined therein and, by its pressure, opposing movement of said element, a valve-controlled conduit for conducting pump discharge water to the dome to compress the air therein and thereby determine the resistance to movement of said element, and engine speed control means adapted for operation by said element.

2. In an automotive fire pumper having an engine, a fire pump driven thereby and adapted to supply a plurality of hose lines, means for automatically maintaining predetermined operation of the pump by the engine comprising an operating pressure chamber, a control pressure chamber, an air dome communicating with and

adapted to drain into said second chamber, conduit means constantly applying the pressure of the pump discharge water to said first chamber, a valve controlled conduit for admitting pump discharge water to said second chamber to establish predetermined pressure therein and means sensitive to predetermined pressure in the first chamber, in excess of that in the second, to reduce the engine speed.

3. In an automotive fire pumper having an engine, a fire pump driven thereby and adapted to supply a plurality of hose lines, means for automatically maintaining predetermined operation of the pump by the engine comprising an operating pressure chamber, a control pressure chamber, an air dome communicating with and adapted to drain into said second chamber, conduit means constantly applying the pressure of the pump discharge water to said first chamber, a valve controlled conduit for admitting pump discharge water to said second chamber to establish predetermined pressure therein, a movable element subject to the opposed pressures in said chambers and adapted to recede and assume successive positions of rest in response to pressure increase in said operating pressure chamber, and engine speed control mechanism adapted for operation by said element, the range of movement of said element, and said mechanism, being correlated to the capacity of the dome to permit pressure increase in said first chamber of not more than approximately ten pounds.

4. In an automotive fire pumper having an engine, a fire pump driven thereby and adapted to supply a plurality of hose lines, means for automatically maintaining predetermined operation of the pump by the engine comprising a control-pressure chamber having an air dome, and an operating pressure chamber, a movable control element subject to pressure in opposite directions by the respective pressures in said chambers, a conduit connecting the discharge side of the pump with said operating pressure chamber throughout operation of the pump, a conduit for conducting pump discharge water to said first-mentioned chamber to compress the air in said dome and thereby determine the resistance to movement of said element, a valve for closing said second conduit, an engine throttle and operating connections from the control element to said throttle adapted to move the latter to reduce the engine speed in response to yielding of said element under predetermined pressure increase in said operating pressure chamber.

HUBERT WALKER.